Flux-Flow Conductivity in Anisotropic Superconductors with a Cooper Pair Mass-Normal Conductivity Anisotropy Mismatch

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Within the time-dependent Ginzburg-Landau (TDGL) theory we evaluate the Bardeen and Stephen contribution to the flux-flow conductivity for uniaxial anisotropic supercondutors. We focus our attention on superconductors with a cooper pair mass - normal conductivity anisotropy mismatch ($\sigma_c\, m_c/\sigma_{ab}\, m_{ab} \neq 1$). Our interest is driven by experimental data on Fe-based oxypnictide superconductors which seem to reveal such kind of mismatch.
Considering the motion of an isolated Abrikosov vortex[1](the weak magnetic field limit), we derive exact asymptotics for the Bardeen and Stephen contribution in two extreme cases: the $l_{Eab} \ll \xi_{ab}$, $l_{Ec} \ll \xi_c$ limit, where l_E is the electric-field penetration length and ξ is the coherence length, and the $l_{Ec} \gg \xi_c$ limit. A variational principle is established which allows us to calculate the Bardeen and Stepehen contribution for superconductors with arbitrary parameters ξ and l_E. The approximate analytical result is compared with numerical calculations. Finally, using the generalized TDGL theory, we prove that the flux-flow conductivity anisotropy may depend on temperature.

[1]N.B. Kopnin, Theory of Nonequilibrium Superconductivity (Oxford University Press, Oxford 2001).